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Hooks in Transverse Fracture
of the Patella

BY

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SURGEON TO THE PHILADELPHIA AND GERMAN HOSPITALS, ASSISTANT SURGEON
TO THE UNIVERSITY HOSPITAL, ETC.

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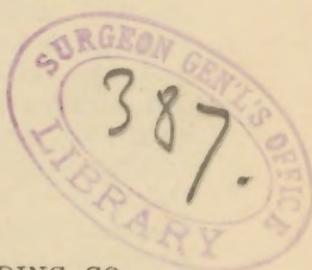
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THE ASEPTIC USE OF MALGAIGNE'S HOOKS IN TRANSVERSE FRACTURE OF THE PA- TELLA.

A. B——, aged thirty, was admitted to the German Hospital in April, 1888. The evening previous, in alighting from a train which had slowed up, but was still in motion, he had made a violent effort to preserve his balance, had felt something give way at the front of the right knee, and had suddenly become unable to use the limb. When examined, twelve hours later, the circumference of the right knee was twenty-one inches as compared with fifteen and a half inches on the left side. There were considerable tension and marked fluctuation. The fragments of the fractured patella were indistinctly felt, separated from each other by an interval of about three inches. He was in considerable pain, and was quite unable to extend the limb. After thorough and scrupulous purification of the skin about the joint I proceeded as follows: A hollow needle was introduced, first to the inner and then to the outer side of the swollen joint, and several ounces of bloody fluid were withdrawn by aspiration. This enabled the fragments to be readily palpated and brought into good position. The apertures made by the aspirating needle being then closed with iodoform and collodion, two pairs of Malgaigne's hooks, which had been previously boiled and soaked in a one to twenty solution of carbolic acid, were placed *in situ*, the upper hooks of each pair being fastened firmly in the edge of the upper fragment close to the insertion of the quadriceps tendon, this being drawn downward. The other hooks were placed in position by being thrust through the soft parts into the in-

ferior edge of the lower fragment. On approximating them, by means of the screw, the fragments of patella were brought apparently into almost perfect position, the line of fracture being barely discoverable, by reason of a slight elevation of the lower edge of the upper fragment. This procedure was effected under antiseptic irrigation, and the limb was then dressed by encircling the joint with moist sublimate gauze, which included and covered in the hooks ; outside of this a layer of sublimate cotton was placed, and the limb was carefully bandaged with an antiseptic roller. It was then placed upon a posterior splint, and the foot elevated for about eighteen inches. The patient had absolutely no symptoms whatever. There was no elevation of temperature, and on the two occasions when the joint was looked at the fragments were found to be in the same excellent position, the injured knee had the same appearance as the opposite knee, and the hooks did not even produce the ulceration of the skin or soft parts which I had anticipated. At the end of five weeks the hooks were withdrawn by easing the points out, first from the lower and then from the upper fragment. This was readily done without disturbance of the broken bone, and an examination then made by my colleagues and myself established the fact that the fragments were in close contact, and that it was barely possible to discover the line of fracture. The limb was again placed upon the posterior splint, the little apertures left after the removal of the hooks were dressed antiseptically, and the patient left undisturbed for some days. The splint was then removed, and a figure of eight bandage placed around the joint. The patient moved and tossed around in bed, but, so far as I could learn, did not get out or make any attempt to use the limb for support or progression. I was about to order slight passive motion, when another examination revealed the fact that a slight separation of the fragments had occurred to the extent, possibly, of three-eighths of an inch. The posterior splint and figure of eight bandage were at once reapplied, and

the question submitted to the patient of the propriety of cutting down and wiring the patella. He declined the operation, and left the hospital some weeks later with a fairly useful limb, the fragments having undergone no further separation.

The proper treatment of fracture of the patella is at the present day still a subject of disagreement among surgeons of experience and ability. The questions to be considered in arriving at a definite conclusion as to the merits of the radical method of cutting down and wiring the fragments are as follows :

1. Are the results obtained by the ordinary methods of treatment satisfactory ?
2. If not, what are the causes of failure ?
3. Is there no method less radical than that of opening the joint and wiring the fragments which will be equally effective ?
4. If the latter be answered in the negative, what are the dangers of the operation of wiring ?

Taking these questions up in the order mentioned, there can be little difficulty in answering the first one in the negative. Every surgeon is familiar with the disability accompanying ligamentous union in cases of transverse fracture of the patella, and it is safe to say that bony union is one of the rarest occurrences after such an injury. The patient, with a fibrous band of an inch or more in length interposed between the upper and lower segments of his patella, will have a gait which is peculiar and unmistakable. He cannot bring forward the foot without flexing the knee, he cannot go downstairs without placing both feet on the same step at the same time, on account of his inability to maintain the leg of the injured side with any certainty in the line of the thigh. If he is in the supine position he cannot lift the limb while holding the leg in full extension. In addition, there is a feeling of uncertainty in standing and walking, frequent and recurrent hydrops articuli, atrophy of the quadriceps femoris, often more or less joint-pain, in many cases the ne-

cessity for a brace or knee-cap, and other minor inconveniences. Refracture is not uncommon, and in the very best cases convalescence is tedious and protracted. These conditions are not exaggerated. While Malgaigne states that he has never seen the function of the limb completely restored even when the separation was limited to one-third of an inch, Dennis asserts that after a careful analysis of a large number of cases treated by the older methods he has found that a separation of the fragments amounting to half an inch is considered a most favorable result.

It is evident, without further argument, that as compared with this condition a close bony union of the fragments is greatly to be desired. Mr. Henry Morris has, to be sure, called attention to the fact that in cases where the fibrous band is very short and firm there is practically no weakening of the joint, and that in such cases, when refracture occurs, it is the bone and not the ligamentous band that breaks. Even admitting these statements as correct, I am convinced, after an independent investigation of the subject, that such results as Mr. Morris describes are extremely rare, and cannot be confidently expected in more than five per cent. of ordinary cases.

2. The alleged causes of failure to procure better results by ordinary methods may be divided into three classes.

a. Mr. Lister believed that non-union was usually due to two factors : The separation of the fragments by the contraction of the quadriceps muscle, and the presence of accumulated fluid within the joint. b. Von Bergmann thinks that the atrophy of the quadriceps, due to the pressure of the dressings employed and to disuse, is progressive, and believes that this condition is responsible for a large proportion of the cases in which it is impossible to extend the limb. c. Macewen believes that the chief cause of non-osseous union is the interposition of fibrous and aponeurotic structures between the

fractured surfaces, and that, before such union can be obtained, it is requisite in the first instance to elevate all the tissues which lie over the fractured surfaces and which prevent them from coming into intimate contact. In explanation of this view he details cases in which he has found portions of the soft parts lying between the fragments, either forced there by the vulnerating body in cases of direct injury, or driven in by atmospheric pressure when the fracture is the result of muscular violence. In such cases the fibrous and aponeurotic structures, being more elastic than bone, the latter breaks first and then retracts, while the soft parts stretch, give way, and are then forced in between the fragments by the pressure of the outside air. Macewen's observations have been corroborated by Hardy, Laylard, and others. Fowler, of New York, reported a case in which he found irregular, shreddy fibres of the soft tissues at the upper edge of the rent intimately adherent to the projecting spiculae of the roughened fractured surface of the upper fragment. Sir Joseph Lister has recently told me that, in his own cases of fractured patella, he had frequently found it necessary to elevate such portions of the soft tissues from between the fragments, and he expressed a general acquiescence in the view which attributes to them the chief importance in the production of ununited fracture.

It is safe to say that the above-named causes include all the chief factors which tend to produce non-union; but much depends upon the relative importance which is assigned to them. It is self-evident that continued separation of the fragments must prevent union by bone. It is almost equally probable that a large unabsorbed or organized effusion of bloody synovia will have the same effect. Atrophy of the quadriceps will, of course, and necessarily, interfere with the further use of the limb and would serve to increase the disability apparently due to the want of bony union. As to the influence of fragments of soft parts interposed between the bones, it would seem, on *a priori* grounds, to be the least potent factor of

the three, as absorption and disappearance of soft and living tissues under such circumstances might reasonably be expected.

One of the strongest advocates of wiring adopts the plan of turning the ends of the wire in between the bones instead of hammering them into their outside surface. This would seem to offer an obstacle to bony union at least equal to that caused by the presence of shreds of fibrous tissue ; but it did not seem to affect his results, which were excellent. It is evident that if Macewen's explanation be the correct one, and the interposition of the prepatellar fibrous structures be the chief cause of non-union, the only rational method of procuring bony union is by cutting down and elevating these fragments of the soft parts. The other indications can, however, be met by much simpler and safer methods of treatment. The exudation in the joint can be removed by aspiration. The fragments can be brought together and held in position by bandages, or by Malgaigne's hooks, as in the case above described. Indeed, immediate aspiration of the joint and the aseptic application of Malgaigne's hooks covered by sterilized or aseptic dressings, together with the use of a posterior splint and a light, moderately firm bandage, would seem to meet every indication except the one which has been mentioned. The use of the hooks enables us to dispense with the excessive pressure by bandages or otherwise required to keep the fragments in apposition. It certainly approximates them more nearly and accurately than does any other method I have ever seen, with the exception of wiring. It combines all the advantages of the old methods by splints and plaster with a greater degree of accuracy in bringing and holding the fragments together. There should be scarcely more risk of septic infection than in an ordinary subcutaneous tenotomy, provided ordinary care as to aseptic precautions be taken at the time the hooks are introduced. If Macewen is mistaken in assigning to the influence of the presence of the prepatellar structures the majority of

cases of non-union, the aseptic use of Malgaigne's hooks would, in my judgment, be the most rational method of treating transverse fracture of the patella. It must be confessed, however, that the case above described rather seems to corroborate MacEwen's theory. I think it quite possible, however, that I removed the hooks two or three weeks too soon ; and that their longer retention might have resulted in a permanent bond of bony union.

In estimating the comparative value of the different methods, it is needless to say that the danger to life should exert a predominant influence. This danger is undoubtedly greater by the method of wiring than by any other plan of treatment. And it is this fact which causes careful surgeons to hesitate to-day in recommending its employment. Of the 186 cases included in the table of Dennis, there were 34 cases of suppuration, 4 amputations, 24 cases in which the result was said to be poor, 14 of them were said to be complete ankylosis, and there were 11 cases which terminated fatally. Of the remainder, 35 were marked as ending with a fair result, 17 of them having incomplete or partial ankylosis. Mr. Lister himself has told us that before he made the incision in the first case of wiring which he ever performed, he remarked to those sitting around him in the amphitheatre that he considered no man justified in performing such an operation unless he could say with a clear conscience that he considered himself morally certain of avoiding the entrance of any septic mischief into the wound.

The opposition at this time (November, 1883) was very strong, and such surgeons as Mr. Bryant, Mr. Adams, Mr. Sidney Jones, Mr. Henry Morris, Mr. Edmund Owen, and Mr. Grant placed themselves on record as opposed to the operation, believing that the bulk of simple fractures do well enough without it, Mr. Christopher Heath going so far as to remark that he thought Mr. Lister's paper would cost many knees and many lives. As recently as August, 1887, we find that Messrs. Barker, Thompson, Stoker, and Robson were equally opposed to the indis-

criminate performance of the operation. The strength of the feeling against the operation, only a few years ago, is well shown by the following conclusions reached editorially by the London *Lancet*, after a full consideration of the subject. They were :

1. That the operation is not suitable as a primary measure ; 2. That in view of all its dangers and of the good results obtained by other and perfectly safe methods of treatment, it is not commendable for general employment ; 3. It is not justifiable unless with most absolute asepsis

The French Academy of Surgery pronounced against it with almost equal force, and the most recent writers on fractures and dislocations have freely agreed with Pick, who says that he would not permit the operation to be done upon himself, and therefore cannot recommend it to his patients.

Mr. Howard Marsh (Art., "Fracture of the Patella," Heath's "Dictionary of Practical Surgery") says that the prevailing opinion in regard to this operation is that in cases of recent fracture it is uncalled for, while in many cases of old fracture it is impossible to carry it out in a satisfactory manner. He adds that he cannot recommend Malgaigne's hooks, as their use has been followed by diffuse inflammation around the patella, and even by suppuration of the knee-joint, ending in some cases fatally, in others in ankylosis, and because, although they draw the fragments more closely together than any other method except wiring, they do not by any means insure bony union. Packard (Article on "Injuries of the Bones," "International Cyclopædia of Surgery," vol. iv.) only countenances resection and suturing when everything else has failed, and it is clear that want of union between the fragments is the sole cause of the disability. Ceci (*Deutsch. Zeitsch. für Chirurg.*, February, 1888) describes a method consisting of a subcutaneous buried suture which surrounds the patella, and passes through the tendons above and below it close to its margin. He reports 5 cases in detail, all of which

were successful. He believes that this plan of treatment has the following advantages: The general applicability of the suture, no matter how great the comminution of the patella; the mechanical union of the fragments, independent of new bone-formation, and affording sufficient and permanent resistance to the disjunctive forces; the subcutaneous character of the entire operation, permitting of rapid and thorough repair of the superficial and deep soft parts, completed in his cases in from four to eight days; the removal of the splints as early as the end of the first week, after which the joint requires neither immobilization nor compression. The practical advantages of the method he thinks may also be seen when it is studied in its relation to the causes of non-union. If, for example, union does not take place on account of blood or synovial exudation, puncture of the joint or aspiration is not required, as the exudation will escape through the openings made to admit the suture, and this emptying the joint can be facilitated by the employment of gentle massage. Atrophy of the quadriceps is to a great extent avoided, by the very early period at which passive motion or even active movement can be permitted. If union is prevented by the interposition of fibrous bands, the subcutaneous wire suture is sufficiently strong to hold the fragments together.

In several of his cases, months afterward, the wires could be felt plainly through the skin and gave rise to no trouble or inconvenience of any sort. The operation appears to bear a close resemblance to that of Volkmann, who employed a silk suture passing out through the quadriceps tendon and through the tendo-patellæ, and to that of Kocher, who passed a silk thread above and below the fragments by means of a transverse or longitudinal incision. König has done a similar operation, employing catgut. I have had no opportunity of testing this operation practically, but it would seem to be open to the same criticism as the use of Malgaigne's hooks; that is, if bony union is the object aimed at by the surgeon in

the treatment of this fracture and if such union is prevented by the presence of fibrous tissue between the fractured surfaces, the encircling wire, while it insures approximation, as do the hooks, will yet fail to bring about osseous repair. It is hard to believe that, in the absence of such union, the wire will permanently hold in place the fragments of a broken patella. It would appear that the methods by buried sutures were at least open to the same objections as the use of the hooks, namely, the risk of consecutive inflammation and suppuration. Cases of this kind have already been reported by Agnew, Hamilton, Volkmann, and others, but in the majority with which I am familiar the hooks were used with little or no antiseptic precaution.

It appears to me that, in connection with this subject, the most important practical point now before the profession for final and conclusive settlement by means of large numbers of carefully observed and recorded cases is that which relates to Macewen's theory of the cause of non-union. This applies to all recent fractures, and in each case which is operated upon by incision and wiring, in all cases of compound fracture of the patella, and in all instances in which patellar fracture is associated with other and fatal injuries and in which an autopsy is attainable, the condition as to the presence or absence of prepatellar fibrous tissue between the fragments should be carefully observed and noted. In old fractures of the patella with marked disability, especially when that disability results from wide separation of the fragments, there is a general concurrence of opinion to the effect that wiring is justifiable. Mr. Lister, however, at the time of his original address upon this subject said that he considered the old ununited cases as in every respect worse subjects for operation than the recent ones. There is certainly one difficulty—that experienced in approximating the fragments—which does not exist in cases of recent fracture. Mr. Turner has reported a case in which the difficulty of bringing the fragments together caused the abandonment

of the operation. Mr. W. E. Ward has recorded one in which the wires repeatedly broke during an attempt to bring together the fragments in a fracture five months old. In these cases Malgaigne's hooks were used and left in for thirty days, the wound and the hooks together being enveloped in a salicylic and iodoform dressing. J. E. Michael and Muskett have each reported cases in which it was impossible to bring about accurate apposition of the fragments. Tenotomy and myotomy of the quadriceps have been resorted to to overcome this difficulty. MacEwen has recommended a series of V-shaped incisions made into the substance of the muscle, as a means of lengthening it without much diminution of its strength. Cameron, of Glasgow, first frees the under-surface of the muscle from the bone by means of a blunt instrument introduced beneath the upper fragment of the patella, and then incises the muscle itself obliquely at two places, the cuts beginning at the inner and outer edges a short distance above the patella and running parallel with each other nearly to the opposite edge. They go through the entire thickness of the muscle and permit of great elongation without complete severance of its continuity. Lister now uses this method in old cases attended with shortening.

In 22 recent cases of wiring, Turner reported no deaths and one case of ankylosis, while in 28 old fractures which were wired there were 2 deaths and 7 cases of ankylosis. I believe that, with our present knowledge of the subject, the following conclusions are justifiable :

1. The results obtained in transverse fracture of the patella by means of splints, plaster dressings, or bandages are extremely unsatisfactory, owing chiefly to the absence of bony union, to the length of the fibrous band interposed between the fragments, and to the accompanying atrophy of the quadriceps muscle.

2. If further observation shows that the chief difficulty in getting good union lies in the separation of the fragments and the presence of blood and synovia, the treat-

ment to be preferred will probably be some form of the prepatellar wire suture or the aseptic use of Malgaigne's hooks after aspiration of the joint.

3. If, however, as seems highly probable, the chief cause of non-union is found to be the presence between the fragments of portions of the aponeurotic tissue in front of the joint, it will be good surgery in all cases of recent fracture to cut down with the strictest and fullest antiseptic precautions and wire the fragments.

4. In old fractures, on account of the increased risk and the difficulty of the operation, the disability of the patient should be quite decided before wiring is recommended by the surgeon.

